**HONORS AND AWARDS** (continued)

National Science Foundation Graduate Fellowship in economics, MIT, 1968-1971.

Joint Service Commendation Medal, 1975

**PROFESSIONAL AFFILIATIONS**

American Economic Association

American Finance Association

The Econometric Society

Referee for *The Rand Journal of Economics*, *Land Economics*, *The Journal of Industrial Economics*

**RECENT PAPERS AND PUBLICATIONS**

"The Failure of Competition in the Credit Card Market: Comment" (with Stephen H. Kalos, Carlos Lapuerta and Stewart C. Myers). Working paper in progress.

"How to Value a Lost Opportunity: Measurement of Damages with or without Hindsight" (with William B. Tye and Stephen H. Kalos). Working paper in progress.

"Event Study of the Effects on Pacific Gas & Electric's Debt of the Guarantee of Pacific Gas Transmission's Debt" (with Lynda S. Borucki). *TBG* report prepared for Pacific Gas & Electric Company, May 1993.

"It's Time for a Market-Based Approach to DSM" (with M. Alexis Maniatis, Johannes P. Pfeifenberger and David M. Weinstein). *The Electricity Journal* 6, 42-52 (May 1993).

*Regulatory Risk: Economic Principles and Applications to Natural Gas Pipelines and Other Industries* (with William B. Tye and Stewart C. Myers). Boston: Kluwer Academic Publishers (1993).

"EPA's 'BEN' Model: A Change for the Better?" (with Kenneth T. Wise and M. Alexis Maniatis), *Toxics Law Reporter* 7, 1125-1129 (February 24, 1993).

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**RECENT PAPERS AND PUBLICATIONS** (continued)

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"The Fair Allowed Rate of Return with Regulatory Risk" (with William B. Tye), *Research in Law and Economics* 15, 129-169 (1992).

"Risk of the Interstate Natural Gas Pipeline Industry" (with Stewart C. Myers and William B. Tye), Washington, DC: Interstate Natural Gas Association of America (October 1991)

"The *Duquesne* Opinion: How Much 'Hope' Is There for Investors in Regulated Firms?" (with William B. Tye). *Yale Journal on Regulation*, Winter 1991.

"How Far Back Should Prudence Tests Reach?" (with William W. Hogan). *Public Utilities Fortnightly* (January 15, 1991).

"Practical Implications of the Supreme Court's *Duquesne* Opinion for Regulated Industries" (with William B. Tye). *Public Utilities Fortnightly* (August 30, 1990).

"Evaluating Demand-Side Options" (with Matthew P. O'Loughlin and Stephen W. Chapel) Palo Alto, CA: Electric Power Research Institute (To appear).

"Financial Constraints and Electric Utility Capital Requirements," (with Matthew P. O'Loughlin) *Proceedings of the 1989 EPRI Utility Strategic Issues Forum.* Palo Alto, CA: Electric Power Research Institute (To appear).

"R&D Project Choice -- Go with the Long Shot" (with Peter A. Morris and Elizabeth Olmstead Teisberg). To appear in *Research • Technology Management*.

"EPRI PRISM Interim Report: Parcel/Message Delivery Services" (with Richard W. Hodges), PHB report prepared for the Electric Power Research Institute, RP-2801-2 (June 1989).

"Capital Requirements for the U.S. Investor-Owned Electric Utility Industry, 1985-2005" EPRI P-5830. (PHB report with Sarah K. Johnson and Matthew P. O'Loughlin). Palo Alto, CA: Electric Power Research Institute (June 1988).

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"The Economics of Midstream Switches in Regulatory Treatments of Deferred Income Taxes Resulting from Accelerated Depreciation" (with William B. Tye and Miriam Alexander Baker). *ICC Practitioners' Journal* (November-December 1983).

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"Inflation-Driven Rate Shocks: The Problem and Possible Solutions." *Public Utilities Fortnightly* 111 (17 February 1983).

"Inflation and Utility Finances: Problems and Possible Solutions." Presented at the NARUC Biennial Regulatory Information Conference. September 1982.

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"Marginal Cost Pricing with Inflation" (with William R. Hughes). Delivered to the IAEE Conference on International Energy Issues. June 1981.

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## CRA Reports (Often Written with Others)

"Flow-Through Versus Normalization of Deferred Income Taxes for Motor Carriers" (with William B. Tye and Miriam Alexander Baker). *Motor Freight Controller* (December 1980).

"Evaluating the Effects of Time and Risk on Investment Choices: A Comparison of Finance Theory and Decision Analysis" (with Applied Decision Analysis, Inc.). Published by the Electric Power Research Institute. January 1987.

"The 'Abandonment Value' of Shorter Leadtimes" (with Applied Decision Analysis, Inc.). June 1985.

"Rate Shock and Power Plant Phase-In: Discussion Paper of Generic Issues." Published by the Edison Electric Institute. December 1984.

# RECENT PAPERS AND PUBLICATIONS (continued)

## CRA Reports (continued)

"Choice of Discount Rates for Utility Planning: A Critique of Conventional Betas as Risk Indicators for Electric Utilities." Published by the Electric Power Research Institute. February 1984.

"Choice of Discount Rates in Utility Planning: An Attempt to Estimate a Multi-Factor Model of the Cost of Equity Capital." December 1983.

"Southern California Edison Company Study of Conservation Potential and Goals." December 1983.

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# APPENDIX B
## EMPIRICAL PROCEDURES

This Appendix contains a description of the inputs used in this report to make recommendations to the commission on the rate of return on assets for the average company in the cable service industry.

Our analysis of the required rate of return on assets consisted of five major steps:

1.  Selection of sample companies to represent the cable service industry and the regulated telephone industry

2.  Collection of financial data.

3.  Calculation of relative risk for our sample of cable service companies, the regulated telephone industry and the S&P 400.

4.  Calculation of relative risk adjusted to the capital structure of the S&P 400.

5.  Calculation of an incremental risk premium for cable service companies relative to the S&P 400 surrogate group.

The selection of sample companies is discussed in the report. This Appendix discusses the remaining points and is organized as follows. Section I contains a description of the data. Section II describes the methodology for the calculation of the relative risk of the two samples and the S&P 400. Section III discusses the leverage adjustments and the incremental risk premium.

## I.     FINANCIAL DATA

Monthly stock price data adjusted for dividends and stock splits, returns for the S&P 500 and returns for the S&P 400 were obtained from Compuserve for December 1982 to the present. Unadjusted stock prices for the last five days of each year were also obtained from Compuserve for the calculation of the market value of equity. Dividend histories for each cable service company from 1988 to the present were also obtained from Compuserve.

Cable service company data on debt, preferred stock, common shares outstanding, book value of equity and net worth were obtained from annual reports. Cable service revenue as a percentage of revenues was obtained from the most recent annual reports. However, when this information was not available in the annual report, it was obtained by calling the company directly. Company bond ratings were obtained from *Standard and Poor's Bond Guide*.

## II. RELATIVE RISK CALCULATIONS

### Company Stock Returns

The monthly return on a stock, $r_E$, is based on the change in share price over the month, plus any dividends paid during the month.

$$r_{E\,t} = [P_t + DIV_t - P_{t-1}] / P_{t-1}$$

where $P_t$ stock price at the end of month t, and $DIV_t$ is the dividend, if any, paid during month t.

### Equity Betas

Equity betas are calculated for the sample of cable service companies, the sample of regulated telephone companies and the S&P 400 for each year from 1987 to 1992. Equity betas for the cable service companies and the S&P 400 were also calculated through the first six months of 1993. The return on one-month U.S. Treasury bills is subtracted from the company and S&P 400 returns before computing betas. To compute a five-year beta for, say, December 1990, returns for the 60 months preceding and including December 1990 (minus the Treasury bill returns) are regressed on the S&P 500 returns (minus the Treasury bill returns). Beta is the slope coefficient in the following regression:

$$\tilde{r}_E - r_f = \alpha + \beta_E (\tilde{r}_m - r_f) + \tilde{e}$$

where $\tilde{r}_E$ is the actual company stock return, $\alpha$ is a constant, $r_f$ is the risk-free (one-month Treasury bill) rate, $\beta_E$ (equity beta) measures risk, $\tilde{r}_m$ is the return of the Standard & Poor's Composite Index (S&P 500), and $\tilde{e}$ is a residual.[1]

## III. LEVERAGE ADJUSTMENTS

The equity beta reflects financial risk brought about by leverage. If the capital structure for a company changes, the equity beta will also change. Equity betas for the sample of cable service companies are relevered to the average capital structure assumed for the S&P 400, 50% debt and 50% equity.

Relevered equity betas, $\beta_E^L$, are derived by first unlevering the equity beta estimated at the current capital structure, $\beta_E$, to get the asset beta, $\beta_A$; then relevering the asset beta at the hypothetical capital structure. Asset betas reflect the risk of assets and operations, exclusive of the financial risk brought about by leverage.[2]

The following formulas are used to unlever and relever the equity betas,

$$\beta_A = \beta_D \times \frac{D}{V} + \beta_E \times \frac{E}{V}$$

$$\beta_E^L = \beta_A \times (1 + \frac{\hat{D}}{E}) - \hat{\beta}_D \times \frac{\hat{D}}{E}$$

where $\frac{D}{V}$ and $\frac{E}{V}$ are the debt-to-value and equity-to-value ratios for the specific cable company, $\beta_D$ is the debt beta for the cable company, $\hat{\beta}_D$ is the debt beta corresponding to the hypothetical capital structure and $\frac{\hat{D}}{E}$ is the hypothetical debt-to-equity ratio.

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[1] For the years 1987 through 1992, the equity betas are estimated for the 60 months preceding and including December of the year, except for 1993 which is a June estimate.

[2] These formulas correspond to the standard regulatory calculation of the weighted average cost of capital.

The debt beta for the S&P 400 is assumed to be equal to 0.25. The debt beta for the average cable company is assumed to be equal to 0.5. The basis for these calculations is in Table B-1. We calculated the implied beta based on yields from the *S&P Bond Guide*, current estimates of the future short-term Treasury yield (estimated as the yield on long-term Treasury bonds less the 1.5 percentage point maturity premium above U.S. Treasury bills) and the market risk premium of 8.5 percent. The implied beta is equal to the difference between actual corporate bond yields and the future short-term Treasury yield divided by the market risk premium.

| TABLE B-1 IMPLIED DEBT BETAS | | | |
|---|---|---|---|
| *Bond Rating* | *S&P Industrial Bond Yield* | *Future Short-Term Treasury Yield* | *Implied Beta* |
| AAA | 6.90% | 5.0% | 0.22 |
| AA | 7.36% | 5.0% | 0.28 |
| A | 7.97% | 5.0% | 0.35 |
| BBB | 8.63% | 5.0% | 0.43 |
| BB | 9.17% | 5.0% | 0.49 |
| B | 10.55% | 5.0% | 0.65 |

The S&P bond rating for most of the cable companies in our sample is a "B" rating. These are highly risky bonds. The results from the table suggest that the implied beta for bonds with this rating are 0.65. However, some of this is a default premium. Therefore, 0.5 is a reasonable estimate of the debt beta for these cable companies. Similar considerations suggest a beta of 0.25 for S&P 400 bonds.

*Market Value of Common Equity*

The market value of common equity is calculated by multiplying the price per share by the number of shares outstanding at the end of the calendar year. The average of the unadjusted prices for the last five trading days of the calendar year is used in the market value of equity calculations.[3]


*Market Value of Debt*

The market value of debt is assumed to equal the book value of debt. The finance theories employed here are developed under assumptions of market values. However, unlike the case for common stock, the book values of debt and preferred stock are generally not widely different from their market values. Preferred issues were generally small, so for simplicity were included in the total value of debt.

The capital structure ratios we use are the averages of the book debt to market value of common equity ratios averaged over the last five years corresponding to the period over which the betas are estimated.


*Value of the Firm*

The market value of the firm is equal to the total market value of debt plus the market value of equity.

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[3]   Prices were obtained for the last five trading days in September 1992 to estimate the September 30, 1992 market value of equity. They were obtained for the last five trading days in June to estimate the 1993 market value of equity.

*Incremental Risk Premium*

The incremental risk premium is calculated in the following way,

$$\text{Incremental Risk Premium} = \left(\beta_E^L - \beta_E^{S+P}\right) \times \text{MRP} \times \frac{\hat{E}}{V}$$

where $\beta_E^{S+P}$ is the equity beta for the S&P 400, MRP is the market risk premium equal to 8.5 percent, and $\frac{\hat{E}}{V}$ is the market equity-to-value to market value of debt and equity under the hypothetical capital structure.